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Advances in Pulmonary Biopsy Techniques

IN THE PAST DECADE, refinements in transthoracic and transbronchial fine-needle aspiration (FNA) techniques, the introduction of thoracoscopic biopsies, and the improvement in lesion imaging and specimen processing have led to a continued decline in the need for open lung biopsies.

The main indications now for percutaneous transthoracic FNA are the biopsy of pulmonary nodules and aspiration of infectious lesions. The diagnostic yield of conventional transbronchial forceps biopsy diminishes with the size of the lesion, whether infectious or neoplastic, so that lesions less than 2 cm to 3 cm are best approached by FNA. In immunocompromised patients, in whom early diagnosis is paramount, small subsegmental and peripheral lesions should undergo FNA under computed tomographic or fluoroscopic guidance because a positive result provides both a diagnosis and confirmation of invasion for otherwise potentially saprophytic organisms like fungi.

Transbronchial FNA by flexible bronchoscopy has the advantage of a lower risk of pneumothorax than percutaneous methods. Its 50% yield in peripheral lesions supplements conventional transbronchial forceps biopsy, washing, and brushing, so that using them together increases the overall yield to about 70%. Compared with transbronchial forceps biopsy, transbronchial FNA is a better technique for metastatic lesions because these tend not to be peribronchial in distribution and hence require deeper biopsies. In addition, about 50% to 60% of malignant mediastinal lymph nodes in paratracheal, subcranial, and aorticopulmonary sites can be sampled with transbronchial FNA guided by computed tomographic images. When successful in the evaluation of lung cancer, this method provides both a cytologic diagnosis and staging, without the need for mediastinoscopy. Because transbronchial FNA has only moderate sensitivity, a negative result does not rule out malignant adenopathy, and it should be noted that the method provides no information about whether disease has spread through the involved node's capsule, a known factor in prognostication. Other uses of transbronchial FNA include the biopsy of extrabronchial compressive lesions and superficially necrotic tumors that require deeper biopsies.

Newer molecular biology and immunohistologic tools have partially eliminated the need for the larger biopsies obtainable only by thoracotomy. Immunohistologic methods using antibodies directed against cell surface antigens can usually separate, for example, reactive lymphocytosis from lymphoma. Gene rearrangement techniques are so sensitive that even cytologic specimens obtained by bronchoalveolar lavage may be adequate for diagnosing certain lymphomas. A polymerase chain reaction assay for *Mycobacterium tuberculosis* holds similar promise for very small or even expectorated specimens in tuberculosis.

When large pleural or parenchymal specimens are required, diagnostic thoracoscopy is now an option. Under general anesthesia, a double-lumen tube is placed to permit collapse of the lung. A rigid thoracoscope is inserted by trocar for plain or video viewing. An operating probe or second thoracoscope, which can incorporate the use of therapeutic carbon dioxide or neodymium-yttrium-aluminum-garnet lasers, is positioned separately to permit wedge excisional biopsy or even segmentectomy. In pleural diseases, thoracoscopy has proved invaluable in diagnosis, and in appropriate cases, therapeutic pleural debridement and even ablation of pleural blebs can be accomplished using these techniques.

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Lung Transplantation

HUMAN LUNG transplantation actually predated heart transplantation, beginning with a single-lung transplant done in 1963. Over the next 15 years, about 44 single-lung transplants were attempted worldwide. The results were uniformly dismal, however, and the procedure was abandoned. Studies of animals suggested that en bloc transplantation of the heart and both lungs provided better vasculature to the tracheobronchial tree, leading to the first successful human heart-lung transplant at Stanford University Medical Center in 1981. This procedure is successful for combined cardiopulmonary disease, particularly congenital heart disease and right ventricular failure associated with pulmonary hypertension. Combined heart-lung blocks are in limited supply, however, stimulating efforts to use lung-only grafts.

Single-lung transplantation was successfully reintroduced in 1983. Major principles advocated were selecting recipients with fibrotic disease only; wrapping the bronchial anastomosis with omentum; not giving preoperative corticosteroids; and avoiding administering maintenance corticosteroids in the early postoperative period. Over the past five years the original principles have been progressively modified: Single-lung transplantation is appropriate for patients with fibrotic disease, emphysema, and perhaps pulmonary hypertension; omental wrapping of the bronchial anastomosis is not required; patients may be successfully transplanted while receiving low dosages of corticosteroids; and instituting corticosteroid therapy immediately following transplantation may be acceptable.

Double-lung transplantation was introduced in 1986. The original procedure involved a low tracheal anastomosis and was technically flawed, with a high rate of tracheal dehiscence. It has now been replaced with bilateral bronchial anastomoses with improved results.

The results of lung and heart-lung transplantation continue to improve with one- and five-year survival rates approaching 75% and 50%, respectively. Candidates for transplantation should have a life expectancy of less than 2 to 3 years without transplantation and be otherwise healthy. Most programs set age limits for transplantation, such as age 60 for single lung, age 50 for double lung, and age 45 for heart-lung transplantation. Rejection monitoring requires frequent assessment of pulmonary function along with bronchoscopy and transbronchial biopsy. The long-term immunosuppression regimen consists of cyclosporine, azathioprine, and prednisone.

Long-term immunosuppression places transplant patients at risk for various unusual infections. In addition, oblitera-